**USDA Hurricane Mitch Recovery Program, Special Objective 1—**
*Damaged Rural Watersheds Rehabilitated through Strengthened Local Capacity.*

## SECTION II: DETAILED SpO 1 ACTIVITIES BY COUNTRY

## B. Country Program Description--Nicaragua

## Program Background and Objectives

USDA's contribution to USAID's Hurricane Mitch reconstruction effort in Nicaragua ended December 31, 2001, over three years after this devastating hurricane ravaged Central America. Hurricane Mitch was considered to be the worst natural disaster to hit the region in two centuries. The greatest loss of life in Nicaragua occurred just north of the town of Posoltega, where two villages were totally buried under a huge mudflow (volcanic *lahar*) that cascaded down the slopes of the Casita Volcano. Over 2000 people lost their lives in this disaster, the path of which was so large that it could be seen clearly from satellite photographs (figure 1).

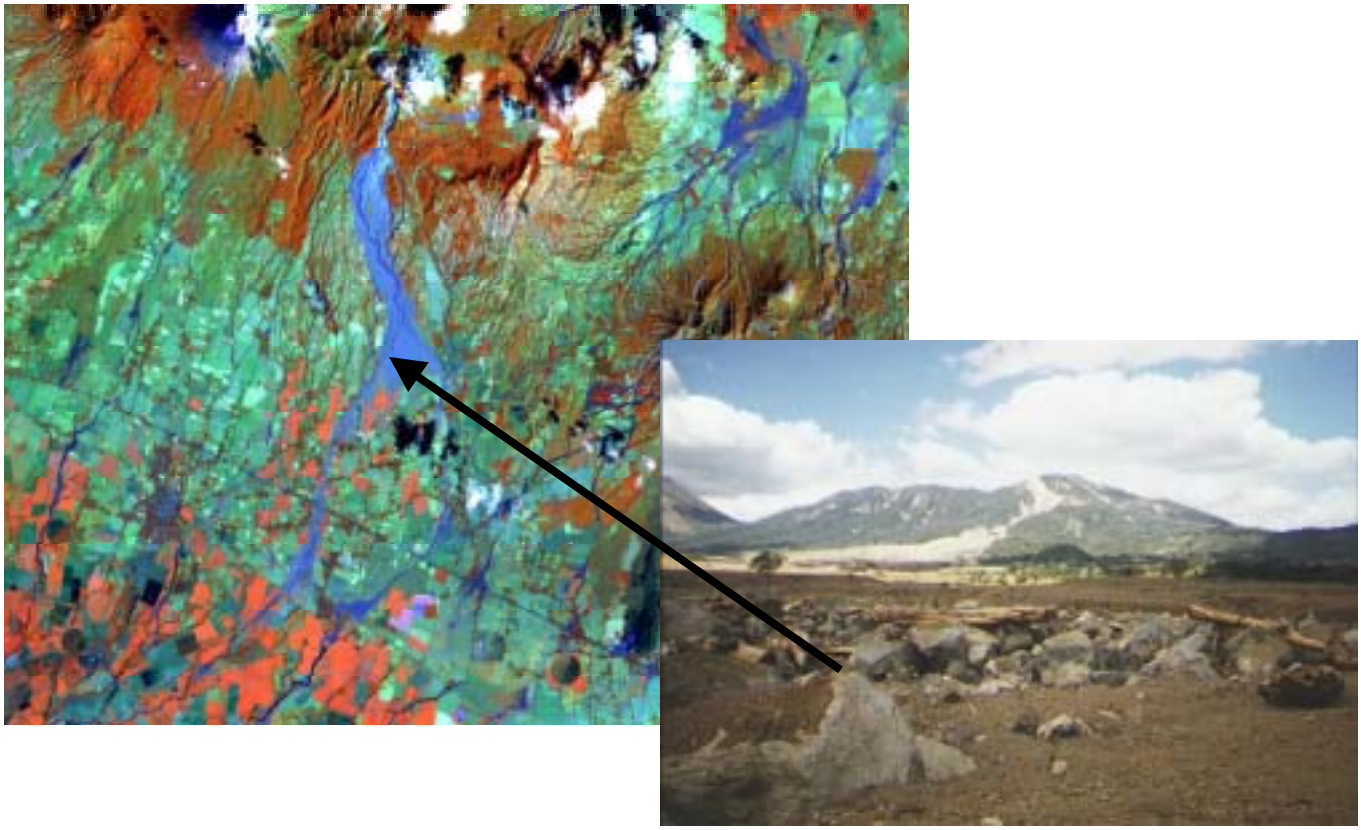

**Figure 1. Satellite and ground photo of the Casita mudflow which killed over 2000 people near Posoltega, Nicaragua during Hurricane Mitch (Oct. 1998)**

Mitch also severely damaged the transportation sector causing extensive damage to roads and bridges. More than 20,000 family homes were damaged or totally destroyed. Within the agricultural sector, more than 25% of the country's cropland was damaged. Damage from Hurricane Mitch covered the entire northern part of Nicaragua (figure 2).

Much of the devastation caused by Mitch was water-related and exacerbated by existing poor agricultural and land management practices. Accordingly, USDA identified the rehabilitation of damaged watersheds as a focal point of its reconstruction effort since it is the quality of watershed management which affects the ability of the land to regulate water runoff, conserve valuable soil and forest resources, protect rural infrastructure, and provide for the myriad of products and environmental services required by an agricultural economy.

During 1999 USDA assessment missions in Nicaragua categorized the impact of Hurricane Mitch with respect to agriculture and natural resources into three areas: 1) urgent watershed threats; 2) damaged agricultural land and roads; and 3) degraded land and water resources. Urgent watershed threats are those impairments to watersheds that posed significant threats to life and property. Without protective measures against such urgent threats, future storms are likely to put at risk both life and property. An example of this is in figure 3 where Mitch severely eroded a streambank to the point where a future storm will threaten to sweep houses in this small settlement into the river channel.

Category two is “damaged agricultural land and roads.” This includes land that has been taken out of production either due to flooding damage, such as rock and sediment deposition, or to direct and massive loss of topsoil, such as the destruction of *Vegas* (fertile agricultural lands along streamsides) (see example in figures 4a and 4b). This also includes roads that have been severely degraded or destroyed and which limit farmer access to markets. These roads also serve as significant sources of sediment.

Finally, category three represents degraded land and water resources which, while still capable of supporting agriculture, are declining in productivity and are highly vulnerable to future storm damage due to a lack of basic conservation and protection practices on cropland, in forests, and in riparian zones. Figure 5 illustrates what can happen to degraded slopes used for agriculture without the adoption of conservation practices. To the extent that land use practices can be improved on these lands, vulnerability to future storm impact can be significantly reduced.


**Figure 2. Mitch-affected zones of Nicaragua encompass roughly the Northwestern part of the country.**

**Figure 3. Streambank damage from Mitch put this small community at high risk for loss of life and property in future storms**

**Figure 4a. Mitch washed away crops leaving gravel where productive crops once stood**

**Figure 4b. (Close-up of 3a) Thousands of tons of soil was lost when Mitch floods scoured existing watercourses**

**Figure 5. Example of a degraded hillside damaged by Mitch**

## Results Framework

USDA's approach to Mitch reconstruction was integrated and multi-faceted, combining USDA's special objective in watershed rehabilitation (with its associated intermediate results) with the relevant intermediate results of USAID, reflecting the unified implementation approach USAID and USDA developed for Nicaragua. USDA's overall Hurricane Reconstruction Goal across all six affected countries is "Reactivation of the Agricultural Sector Damaged by Hurricanes Mitch and Georges." This had its counterpart in the USAID Nicaragua Special Objective: "Rapid Reconstruction and Sustainable Recovery in Mitch-affected Areas."

To achieve these overall goals USDA and USAID/Nicaragua jointly developed a program consisting of the following results:

- Economic livelihood of farmers, laborers, micro-entrepreneurs in Mitch-affected areas restored (USAID IR 1.2)

- Vulnerability to flooding and other natural disasters mitigated (USAID IR 1.3)

Based on the three categories of impact previously described, USDA and USAID developed a response package with the following components listed below. Under each component are placed those intermediate results from both the USAID and USDA results framework which apply. Note that certain intermediate results occur more than once. For example, road rehabilitation is an IR under emergency watershed protection (EWP) reflecting the importance of roads rehabilitation in

EWP. Similarly, less urgent road rehabilitation (i.e., non-exigencies) would also be a component in the overall rehabilitation component.

**1. Emergency Watershed Protection**

- Emergency Watershed Protection implemented for critical sites (USDA IR 1.1)
- Critical watersheds stabilized (USAID IR 2.3)
- Farm-to-market roads rehabilitated (USAID IR 2.4)
- Threat conditions mitigated (USAID IR 3.1)
- Increased local capacity to prepare for, and cope with, natural disasters (USAID IR 3.2)

**2. Rehabilitation of Land and Water Resources**

- Land and water resources rehabilitated in priority watersheds (USDA IR 1.2)
- Agricultural land reclaimed and rehabilitated (USAID-IR 2.2)
- Farm-to-market roads rehabilitated (USAID IR 2.4)

**3. Increased capacity to withstand storms**

- Local Capacity to Mitigate Future Storm Effects Strengthened (USDA IR 1.3)
- Environmentally sustainable agricultural practices adopted (USAID IR 2.1)
- Increased local capacity to prepare for, and cope with, natural disasters (USAID IR 3.2)

**Watershed Field Assessments**

Between early March and mid-June 2000 a major field assessment was undertaken by five multi-disciplinary USDA technical teams to specific NGOs within the primary watersheds of the Mitch-affected zones. Results of the five watershed assessments covering most of the Mitch-affected zones generated a master list of sites needing rehabilitation. Based on this list, USDA's long-term staff, in conjunction with USAID's Enterprise and Rural Development office, developed a strategy for rehabilitating significant numbers of these sites impacted by Hurricane Mitch.

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**Planned implementation activities**

USDA's work comprised 5 separate components covering a wide range of activities (see table 1 below). During the project field activities were managed by two long-term resident USDA Advisors. These Advisors were both detailed to Nicaragua from the USDA Natural Resources Conservation Service (NRCS). Mr. Carlos Suarez, a District Conservationist from Indiana, managed activities related to the rehabilitation of agricultural land, reforestation and the mitigation of future storm effects. Mr. Ildefonso Chavez, an engineer from Arizona, managed activities related to road rehabilitation and the repair of watershed exigency sites. The later sites tended to require significant engineering and construction expertise. Both USDA employees managed a large number of short-

term USDA technical specialists who provided expert technical assistance in support of the various technical components described below.

| ACTIVITY | IMPLEMENTORS |
|---|---|
| | |
| Agricultural Land Rehabilitation and Protection | UPANIC; CHF |
| Reforestation in the Mitch Zone | National Seed Center; USAID-funded Partners |
| Pine Bark Beetle Control Project | World Relief; INAFOR |
| Elimination of Watershed and Infrastructure Exigencies | FISE |
| Road Rehabilitation | USAID-funded PVO/NGO Partners |

**Table 1. USDA primary project components**

## Key Accomplishments/New Technologies

The following section describes key accomplishments under the 8 components mentioned above. Several of the components are very large sub-projects which have separate detailed reports prepared by the implementing organization. Readers requiring more detail than that supplied here are encouraged to contact USDA directly. While this section is organized by implementation component, the relevant intermediate results for USDA and for USAID are listed in parentheses under each component.

**Key Accomplishments--Component A.**
***Agricultural land rehabilitation and protection (USDA IR 1.2; USAID IR 2.1, 2.2)***

**A1-Small grants program for mitigation activities in areas affected by Hurricane Mitch**
**Implementing Organization:**
**Union of Nicaraguan Agricultural Producers (UPANIC)**
**Funding Level: $1,294,866**

USDA and UPANIC signed an agreement in November 2000 to rehabilitate through a small grants program selected sites of Mitch damage identified by USDA's watershed assessment teams earlier in the year. Through a competitive process, 50 organizations submitted proposals to implement 70 projects. After a comprehensive review process 24 organizations were selected to implement 29 projects.

These projects were implemented on 133 separate sites benefiting 12,493 households directly. The program was divided into 3 categories of work: 1) rehabilitation of farmland, 2) restoration and

stabilization of watercourses and drainages, 3) reforestation. Table 2 summarizes the sub-grants by category, sites, funding level and number of households directly benefiting.

| Organization | Number of projects | Number of sites | Funding amount ($) | Number of households |
|---|---|---|---|---|
| | | | | |
| Rehabilitation of farmland | 12 | 62 | $251,876 | 1,605 |
| Restoration and stabilization of watercourses and drainages | 8 | 25 | $284,653 | 8,599 |
| Reforestation | 9 | 46 | $197,969 | 2,289 |
| **Totals** | **29** | **133** | **$734,498** | **12,493** |

**Table 2. Summary statistics for UPANIC sub-grants**

**A1.1 Sub-Projects on rehabilitation of farmland**

**Overall accomplishments for component:**

- **12 projects implemented at 62 sites**
- **871.5 hectares of farmland rehabilitated**
- **1,605 households adopted improved agricultural practices**
- **409,582 trees planted including 300,000 fruit trees**

Individual sub-grants are highlighted below:

**Grant Title: Planting of grafted fruit trees for soil rehabilitation in El Higueral, Chinandega Municipality, Chinandega Department**
Grantee: Foundation Augusto Cesar Sandino (FACS)
Amount: $6,662

Key accomplishment:

Establishment of 2,560 fruit trees (orange, mango, lemon, avocado) in 134 parcels of El Higueral

**Figure 6. Grafted mango seedling planted in community parcel**

**Grant Title: Planting of grafted fruit trees for soil rehabilitation in 4 municipalities north of Chinandega, Chinandega Department**
Grantee: Society Garmendia Jiron
Amount: $12,372

**Key accomplishment:**

Establishment of 7,000 fruit trees (mango, avocado, orange) in 226 parcels of El Higueral

**Figure 7. Mango seedling just grafted**

**Grant Title: Rehabilitation of Agricultural Land and Reforestation on the Shores of the Coco River, Waspam Municipality, North Atlantic Autonomous Region (RAAN)**

Grantee: Foundation for the Unity of Reconstruction of the Atlantic Coast
Amount: $47,000

Key accomplishments include:

-11 community nurseries established
-173 acres reforested
-23.3 km of soil contours constructed
-5.8 km of terraces constructed
-5.8 km of drains constructed
-25.5 acres of slope protection with grasses completed
-39 training seminars on conservation given

**Figure 8. Community tree nursery**

**Grant Title: Rehabilitation of agricultural lands in 4 communities of the municipality of San Sebastian de Yali in Jinotega, Jinotega Department**

Grantee: Association of Coffee Growers of Jinotega (ASOCAFEJI)
Amount: $9,595

## Key accomplishments include:

- 4.6 km of living fences rehabilitated
- 7,200 trees planted on 89 separate parcels
- 50 parcels rehabilitated by planting 11,650 coffee plants (variety 'Caturra').

**Figure 9. Live fence rehabilitation at Pavona Arriba**

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**Grant Title: Rehabilitation of agricultural lands and riparian areas in Casa Blanca and San Antonio, Pueblo Nuevo Municipality, Esteli Department**

Grantee: Association of Coffee Growers of Esteli (ASOCAES)
Amount: $21,604

**Key accomplishments include:**

- 26.8 km of living fences established
- 86.5 acres of riparian zone reforested
- 10.1 km of Taiwan grass barriers established
- 32,850 trees planted
- 277 acres planted with improved corn, bean and sorghum varieties

**Figure 10. Live barriers of Taiwan grass**

**Grant Title: Implementation of silvo-pastoral management system in the Dipilto Municipality, Nueva Segovia Department**
Grantee: Association of Development of Forests Campesino (ADEPROFOCA)
Amount: $5,983

Key accomplishments include:

- 6.6 km of fences rehabilitated
- 7,200 live posts established
- 10 km of micro-irrigation installed
- 12,600 cuttings of Taiwan grass and cane planted

**Figure 11. Taiwan grass established in parcel of the Rodeo Grande community**

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**Grant Title: Implementation of a system of silvo-pastoralism and a seed bank in the communities of the Terrero, Malpaisillo Municipality, Leon Department**
Grantee: Cooperative "Eddy Castellon Cisneros"
Amount: $14,500

Key accomplishments include:

- 17.7 km of living fences established
- 17.7 km of fence rehabilitation
- 18.6 hectares reforested with 29,890 fruit and forest seedlings produced at project nursery
- 49 hectares of land prepared and sown with 'Angleton' grass

**Figure 12. Distribution of seedlings from project nursery**

**Grant Title: Rehabilitation of productive systems and preservation of natural resources in the community of El Bonete, Terrabona Municipality, Matagalpa Department**
Grantee: Association of Agricultural Service and Rural Development (AGRODERSA)
Amount: $35,969

**Key accomplishments include:**

- 93.3 km of living fences established
- 12.7 km of dead barriers established
- 41.5 km of drains constructed
- 65,960 forest trees produced

**Figure 13. Live fences established in El Bonete**

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**Grant Title: Rehabilitation of agricultural lands and riparian areas in Rio Grande and Rio Abajo, Pueblo Nuevo Municipality, Esteli Department**

Grantee: Association of Coffee Growers of Esteli (ASOCAES)
Amount: $19,505

**Key accomplishments include:**

- 10.1 km of living fences established
- 6.0 km of live barriers established with Taiwan grass
- 21 hectares reforested in a riparian zone
- 76 hectares with improved varieties of corn (NB-6), beans (DOR-364), and sorhgum (pinolero)

**Figure 14. Field established in Rio Grande with improved varieties of beans and sorghum**

**Grant Title: Implementation of a Silvo-pastoral system and creation of a seed bank-Los Tablones, Somotillo Municipality, Chinandega Department**

Grantee: Foundation Chinandega 2001
Amount: $9,717

**Key accomplishments include:**

- 6.3 km of fences rehabilitated
- 13.3 hectares of land planted with Angleton grass seed for a grass seed bank

**Figure 15. Producers benefiting from the project**

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**Grant Title: Rehabilitation and preservation of the natural resources on the shores of the Achuapita River, Achuapa Municipality, Leon Department**

Grantee: UDECO
Amount: $30,698

**Key accomplishments include:**

- 101,000 tree seedlings produced
- 101,000 seedlings planted along 6 kilometers of the Achuapita river
- 47 km of terraces established
- 2,300 stakes of madero Negro, pochote and mahogany established for live fences
- 105 hectares of drought resistant maize (NB-S) planted
- 45 parcels of improved production established (poulty, tomatoes, cucumber, etc.)

**Figure 16. El Rodeito communal nursery**

**Grant Title: Establishment of agroforestry systems on the slope of Casita Volcano, Posoltega Municipality, Chinandega Department**

Grantee: Association of Nicaraguan Foresters
Amount: $38,325

Key accomplishments include:

- 24,000 tree seedlings planted
- 13 training seminars held on agroforestry and soil conservation
- 7 km of live barriers established with pineapple
- 58 hectares of maize, beans, and pitahaya (cactus fruit)
- 3.4 hectares established with 60 forest species for the arboretum in the Casita Memorial Park

**Figure 17. Arboretum in the Casita Volcano Memorial Park in memory of those killed at this site during Hurricane Mitch**

**A1.2 Sub-Projects on restoration and stabilization of watercourses and drainages**

**Overall accomplishments for this component:**

- **8 projects implemented at 25 sites**
- **23,502 cubic meters of sediment removed from targeted waterways**
- **5 box bridges constructed**
- **5 ford bridges constructed**
- **5 pedestrian bridges constructed**
- **6 culvert bridges constructed**
- **1800 meters of irrigation canal constructed**
- **4.3 km of river banks stabilized via bio-engineering treatments**
- **1.4 km of critical watercourse segments repaired**
- **4.16 km of gullies treated**

Individual sub-grants are listed on below:

**Grant Title:** **Rehabilitation of slopes, waterways and roads in the communities of Paso Ancho, El Pastoreo, La Tunoza and Agua Fria, Esteli Municipality, Esteli Department**
Grantee: Livestock Association of the North (ASOGANOR)
Amount: $4,981

**Grant Title:** **Channel restoration and ford construction in the Pire River at San Jose de Pire, Condega Municipality, Esteli Department**
Grantee: Cooperative Housing Foundation (CHF)
Amount: $14,796

**Grant Title:** **Construction of box bridges and rehabilitation of channels in La Villa 15 de Julio Municipality, Chinandega Department**
Grantee: Association of Alternative Productive Development (ADEPAL)
Amount: $48,027

**Grant Title:** **Restoration and rehabilitation of channels in the districts of Cristo el Rosario, Nicarao and Teodoro Lopez, Ocotal Municipality, Nueva Segovia Department**
Grantee: Association of Municipalities of Nueva Segovia
Amount: $47,718

**Grant Title:** **Construction of shoal bridges with drainage and contention walls at Lose Higuitos, Las Jaguas and Tapacales, Macuelizo Municipality, Nueva Segovia Department**
Grantee: Polos de Desarrollo “la Asuncion”
Amount: $54, 050

**Grant Title:** **Restoration and stabilization of a channel segment in the Nuevo Pueblo River, Pueblo River Municipality, Esteli Department**
Grantee: CLUSA-ZAMORANO
Amount: $23,364

**Grant Title:** **Restoration and stabilization of a channel in the districts of El Tule, Santa Teresita, and Apoyo al Combatient, Matagalpa Municipality, Matagalpa Department**
Grantee: Club of Young Environmentalists (CJA)
Amount: $23,364

**Grant Title:** **Rehabilitation of drain for water conduction in the community of Mozonte, Mozonte Municipality, Neuva Segovia Department**
Grantee: North Multisectoral Cooperative (COONORTE)
Amount: $46,000

In figure 18 (a-f) are selected photos from several of the above grants.

**Figure 18a. Ford constructed in Pire River (CHF)**

**Figure 18b. Box bridge at El Higueral (ADEPAL)**

**Figure 18c. Drainage channel rehabilitation (AMUNSE)**

**Figure 18d. Rehabilitated irrigation canal (COONORTE)**

**Figure 18e. Early stage of stream bank restoration using bio-engineering techniques (CLUSA-Zamarano)**

**Figure 18f. Same area as in 18e after vegetation has become established (CLUSA-Zamarano)**

## A1.3 Sub-Projects on reforestation

**Overall accomplishments for this component:**

- 9 projects implemented at 47 sites
- 93 hectares of forest planted in highly vulnerable points Mitch-damaged micro-watersheds
- 1,000,000 trees planted
- 54 different species planted including:
  - 178,000 Ocote Pine (*Pinus oocarpa)*
  - 168,000 Madero Negro (*Gliricidia sepium)*
  - 102,000 Neem (*Azadirachta indica)*
  - 92,000 willows (*Salix sp.)*
  - 27,000 oranges (*Citrus sativa)*
  - 24,000 mangos (*Mangifera indica)*

**Individual sub-grants are as follows:**

**Grant Title: Reforestation of 12.5 km on the shores of the Viejo de Dario and Sinecapa river in Leon, El Jicaral Municipality, Leon Department**
Grantee: National Union of Farmers and Cattlemen (UNAG)
Amount: $6,000

**Grant Title: Reforestation of 140 hectares of forest along the shores of the Galilao and Madrono Rivers in Leon, Malpaisillo and El Jicaral Municipality, Leon Department**
Grantee: Institute of Investigations and Social Management
Amount: $5,852

**Grant Title: Reforestation of 20 km on the shores of the Palacaguina River in Madriz, Palacaguina Municipality, Madriz Department**
Grantee: Association for the Integration of the Abandoned Population of Nicaragua (AIDEP-NIC)
Amount: $22,285

**Grant Title: Forest replacement in the municipalities of La Paz Centro, Posoltega and Leon, Leon and Chinandega Departments**
Grantee: Fortification Project of the Association of Forest Replacement (PROLENA)
Amount: $8,000

**Grant Title: Reforestation of 14 km on the shores of the Chiquito and Pochote Rivers in Leon, Leon Municipality, Leon Department**
Grantee: Association for Community Development(UDECO)
Amount: $6,000

**Grant Title: Reforestation of 20 km on the shores of the Villaneuva River, Villaneuva Municipality, Chinandega Department**
Grantee: Foundation Chinandega 2001
Amount: $12,574

**Grant Title: Reforestation of 20 km on the shores of the Gallo River in Somotillo, Somotillo Municipality, Chinandega Department**
Grantee: Foundation Chinandega 2001
Amount: $12,690

**Grant Title: Reforestation in five communities on the shores of the Yalaguina River in Madriz, Yalaguina Municipality, Madriz Department**
Grantee: Association for the Integration of the Abandoned Population of Nicaragua (AIDEP-NIC)
Amount: $38,043

**Grant Title: Reforestation of 20 km on the shores of the Negro River in Somotillo, Somotillo Municipality, Chinandega Department**
Grantee: Foundation Chinandega 2001
Amount: $12,690

**Grant Title: Reforestation of 30 hectares of forest and forest certification in the municipality of San Jose de Cusmapa. San Jose de Cusmapa Municipality, Madriz Department**
Grantee: Familia Padre Fabretto
Amount: $78,836

In figure 19 (a-f) below are selected photos from several of the above grants.

**Figure 19a. Nursery-INGES Project**

**Figure 19b. Nursery-Foundation Chinandega 2001 Project**

**Figure 19c. Newly planted Pochote (UDECO)**

**Figure 19d. Reforestation Brigade (Padre Fabretto)**

**A2-Agricultural land rehabilitation and protection projects undertaken by the Cooperative Housing Foundation (CHF)**

CHF International implemented projects under this component in watersheds of the Estelí and Pire Rivers located in the Municipalities of Estelí and Condega, Department of Estelí, Nicaragua. The purpose of the projects, beyond rehabilitating damaged agricultural land, was to reduce the vulnerability for the families that had been affected by natural phenomena such as Hurricane Mitch in October 1998 and the drought that affected the various farm production systems in the zone during the summer of 2001.

The mitigation and conservation projects constructed were complemented by an educational component directed at the residents of the zone: the men, women and children. The following list outlines the key accomplishments:

a) **Reservoirs and irrigation systems**
   - **403 reservoirs constructed**
   - **253 small irrigation systems installed**
   - **491 individuals trained**

Small reservoirs constructed with appropriate technology are relatively simple and inexpensive to build. They provide for the rational use of rainwater or fresh water from natural resources. The benefits realized through the construction of these reservoirs were increased income from the sale of vegetables, livestock or poultry and an improved standard of living with a near-by, safe water supply.

Reservoirs were of two types: 1) plastic lined with compacted clay and 2) clay mixed with a small proportion of sand, dirt and cement. Figure 20 shows a typical plastic type of reservoir. Irrigation systems using appropriate technology were sometimes constructed to complement the reservoirs. The systems constructed were sprinkler and drip irrigation systems (tape type and screw type).

**Figure 20. Example of reservoir constructed by CHF in Esteli Department**

**b) Watershed rehabilitation projects (Esteli River Watershed)**

- **571 hectares protected by soil and water conservation interventions**
- **86.2 hectares reforested with fruit and forest tree species**
- **783 Men, 148 women and 625 students trained**

The projects included the following activities

a) The construction of lateral terraces
b) The construction of rock barriers
c) The rehabilitation of construction works
d) Reforestation using forest and fruit tree varieties
e) The establishment of live barriers
f) Training events in disaster preparedness and mitigation construction activities

**c) Reforestation along the Pire River**

- **14.9 hectares reforested with 18,700 trees**
- **4.8 hectares of land with installed irrigation systems**

CHF during 2001 had the opportunity to expand its impact by undertaking additional reforestation activities near the Pire River. Accordingly, USDA amended the existing agreement to finance activities which achieved the outputs listed above. The 18,000 trees planted included 4,700 fruit trees, 6,000 bananas and 8,000 forest species.

**d) Pire River Streambank Protection Project at Santa Teresa Community**

- **398 lineal meters of terraced embankments 3 meters high and 20 meters wide were built**
- **139.5 linear meters of a border wall four meters high were constructed**
- **450 meters of the river dredged at 45 degrees with an average width of 55 meters**

This project near Santa Teresa was designed to benefit 12 communities with a total population of approximately 3,000 families located along the banks of the Pire River. Condega is one of the municipalities (within Esteli Department) that suffered the greatest loss of life, housing, crops, household goods, livestock, and poultry in all of Nicaragua from Hurricane Mitch. USDA devoted considerable technical assistance in terms of design and oversight during implementation. Figures 21-23 shows scenes from the project site—one of the larger and more complex projects of its type.

**Figure 21. Gabion construction to reinforce banks of the Pire River**

**Figure 22. Stabilization of stream banks**

**Figure 23. NRCS Engineer David Bandrowski surveying Pire River site**

**<u>Key Accomplishments--Component B</u>** ***Reforestation in the Mitch Zone (USDA IR1.2, USAID 2.3)***

**Promoting reforestation after Hurricane Mitch**

**Key accomplishments:**

- **329,750 seedlings produced**
- **168,620 seedlings sold**
- **124,815 trees planted**
- **97 hectares reforested**
- **National tree seed center reactivated**

In addition to the extensive reforestation undertaken as part of the UPANIC small grants project, USDA helped coordinate and promote reforestation activities among the NGO community at large. Part of the plan was the reactivation of the national forest tree seed center. This allowed the center to undertake forest tree seed collections in 2000 and 2001 so that adequate supplies of seeds would be available for NGOs and others to purchase for production of nursery seedlings. Forest tree seed specialists from USDA and North Carolina State assisted with this process, which included a review of seed storage and seed testing protocols.

USDA, as part of the plan, supported 5 cooperatives in the Department of León (Cooperativa de Productores Agroforestales de Quezalguaque [COPAQUE], Cooperativa de Productores Agroforestales de León [COPAFLE]; Cooperativa de Productores Agroforestales de Telica [COPAT]; Cooperativa de Productores Agroforestales de Lareynaga-Malpaisillo [COPALMA]; and Cooperativa de Productores Agroforestales de Posoltega [COPAPO]). The support included nursery technical assistance (2 nursery technicians), seeds, tools and materials, and some occasional transportation. The target was to produce approximately 400,000 tree seedlings for community reforestation programs.

**Key Accomplishment Component C**
***Pine Bark Beetle Control Project (USDA IR1.1, USAID 2.3)***

**Controlling an Outbreak of Bark Beetles in Northern Nicaragua**

The Southern pine beetle, Dendroctonus frontalis Zimm., which is the most destructive insect pest of pine in the southern United States and Central America, is currently in outbreak status in Nicaragua and several other Central American countries. The outbreak in Nicaragua began after Hurricane Mitch in 1999 near Jalapa in northern Nicaragua, which is close to the Honduran border (Figure 1). While it is not clear if there is a causal relationship between Mitch and the beetle outbreak, it is clear that beetle outbreaks can degrade vulnerable watersheds by killing trees and exposing soils to rainfall. Thus the control of the outbreak was viewed as an important action necessary to reduce watershed vulnerability to future storms.

Initially an infestation covering 30 hectares was detected in Teotecacinte, a municipality of Jalapa, Nicaragua. Due to a lack of resources by the government of Nicaragua and no clear direction or plan

to follow, little was done to reduce the impact of the beetle and the outbreak continued to increase to a high level during the next year.


**Figure 24. Location of the Southern Pine Beetle outbreak in Nicaragua (black rectangle)**

By the spring of 2001 the beetle epidemic had spread to over 6000 hectare and had killed tens of thousands of trees. Not only did this mortality represent a significant loss in timber value, the dead trees would eventually create a fire hazard as well as expose fragile soils to erosion in future storms. Based on an expert consultation from USDA entomologist Dr. Ron Billings, a control effort was mounted starting in May of 2001.

World Relief, working with the Nicaragua Ministry of Agricultural and the Nicaraguan forestry agency (MAGFOR/INAFOR), was contracted by USDA to create a containment strip to stop the spread of the beetles. This method requires the establishment of a buffer area between infected trees and uninfected trees, which disrupts the natural biology of the beetle, leads to high beetle mortality, and essentially keeps the infestation from growing larger. Accordingly, a containment strip approximately 200 meters in width and 13 kilometers long was established.

In late January and early February of 2002 USDA sent Forest Service entomologist Denny Ward to evaluate the effectiveness of the control strip and investigate reports of outbreaks elsewhere in

Nicargua. Key findings are:

- **The intensity of the primary outbreak has declined. Field surveys show:**
  - Inactive infestations
  - High beetle mortality from pitch in green trees
  - Poor brood survival
  - Noticeable increase in natural enemies of the bark beetle

- **In spite of the decline many infestations exist with potential to cause additional serious mortality**
- **Two control strips at Santa Barbara and San Fernando were completely successful at stopping beetle spread**
- **Control efforts for new and small outbreaks need to continue to prevent them from becoming large an uncontrollable**

**Key Accomplishment Component D**
***Elimination of Watershed and Infrastructure Exigencies (USDA IR1.1, USAID 3.1)***

This component of the project targeted relatively large sites of Hurricane Mitch damage representing significant watershed impairments that posed significant threats to life or property ("exigencies") if left untreated. Most of these sites were identified during the USDA-led watershed field assessment, and included damaged river channels threatening important infrastructure, bridge and road repair, the protection of a hospital from flooding and other similar projects.

The elimination of these major exigencies required significant engineering expertise in both the planning and implementation of the work. To accomplish this work USDA worked very closely with a Nicaragua organization known as the FISE (Emergency Social Investment Fund). FISE managed the overall project with extensive assistance from USDA engineers from NRCS. The USDA engineers provided almost continuous support, under the direction of USDA in-country staff, by reviewing design documents and drawings and by visiting field sites throughout implementation. Local engineering firms were contracted to prepare architecture and engineering designs that were then let out for competitive bidding by local contracting firms. NRCS engineers worked with FISE engineering staff to ensure quality control during construction.

**Projects completed under this component of the work are summarized on the following pages**.

**Puerto Momotombo**
Municipality: La Paz Centro  Department: Leon
GPS Coordinates: N12degrees  21.912', W86 degrees 39.910'
Location: Approx. 65 KM NW from Managua

This project protected the downstream community from flooding and consisted of three components. These were gabion dikes at two critical points, a masonry concrete low water crossing, and stream barbs to protect vertical banks along an adjacent floodplain.  Figures 25a and 25b show pre-construction and post-construction views of the project site.

**Figure 25a.  Pre-construction photo of Puerto Momotombo site**

**Figure 25b. Post-construction photo of Puerto Momotombo gabion dike**

**El Hatillo bridge and stream bank stabilization**
Municipality: Sebaco Department: Matagalpa
Bridge and stream bank stabilization
Location: Approx. 150 KM North of Managua

This project constructed a new bridge thus establishing an important farm-to-market road connection between the local El Hatillo community and regional agricultural markets. Stream bank stabilization was undertaken adjacent to the new bridge to protect the area from flooding. USDA also collaborated with CARE in rebuilding local irrigation systems for small farmers near to this site. Figures 26a is a shot of the damaged remnants of the old bridge and road after Mitch. Figure 26b celebrates the inauguration of the completed project in November 2001.

**Figure 26a. El Hatillo site damaged by Hurricane Mitch**

**Figure 26b. Inauguration of El Hatillo bridge project-November 2001**

**Salale Flood Protection**
Municipality: El Sauce Department: Leon
Bridge and stream bank stabilization
GPS Coordinates: N13 degrees 38.057', W86 degrees 28.457'
Location: Approx. 185 KM North from Managua

This work consisted of constructing gabion baskets which extend from the banks of an upper flood plain to encourage channel flows to return toward the river by the placement of stream barbs along the same banks

**Hospital La Trinidad Flood Protection**
Municipality: La Trinidad Department: Esteli
Geographic Coordinates: N12 degrees 58.313', W86 degrees 14.014'
Location: Approx. 135 KM North of Managua

This work was originally contemplated as a concrete lined channel leading around the perimeter of the hospital property that was severely damaged by Hurricane Mitch. For maintenance and cost reasons this project was redesigned to construct low dikes linked to water diversion structures on the slopes above the hospital with drainage along both sides of the hospital complex.

**La Quimera Bank Protection**
Municipality: Telica Department: Leon
GPS Coordinates: N12 degrees 32.110', W86 degrees 50.094'
Location: Approx. 125 KM NW from Managua

This work consisted of constructing Gabion jetties in order to divert water away from unprotected stream banks and assist in conveying it through a bridge crossing (figure 27).

**San Juan De Limay Bank Flood Protection**
Municipality: San Juan de Limay Department: Esteli
GPS Coordinates: N12 degrees 32.110', W86 degrees 50.094'
Location: Approx. 125 Km NW from Managua

This work consists of constructing gabion stream barbs and structures along the outer riverbanks in order to protect the adjacent community from flooding and loss of property.

**Figure 27. Completed section of La Quimera bank protection project**

**Figure 28. Completed section of La Quimera bank protection project**

**Key Accomplishment Component E**
***Road Rehabilitation (USDA IR 1.1, IR1.3; USAID 2.4)***

- **USDA's technical assistance and leadership was instrumental to the rehabilitation of 1388 kilometers of damaged rural roads by Nicaraguan NGOs (CARE, Save the Children, PCI, ADRA). This contribution included technical coordination in the delivery of 10 technical trainings.**

- **USDA contributed road rehabilitation technical training materials that were instrumental to increasing the capacity of Nicaragua NGOs and government technicians to design and maintain quality rural roads. Materials included:**

    - **100 copies of the USDA manual "Rural Roads with Minimal Impact"**
    - **100 copies of the USDA's "Best Management Practices Guide for Forest Roads"**
    - **500 copies of the Nicaragua "Road Rehabilitation and Maintenance Manual"**

Poor rural roads were both a consequence and a cause of watershed damage under Hurricane Mitch. Roads with poor designs and maintenance are more vulnerable to hurricanes, or even regular storm events, then well-maintained roads. Poorly designed roads are more likely to cause watershed damage than almost any other rural activity, leading to increased soil erosion and sedimentation, blockage of waterways, and in some cases landslides.

USDA's long-term advisor for this component played a key role in coordinating a technical working group of road engineering and other NGO staff among the four principal NGOs implementing road rehabilitation projects to repair damage caused by Mitch. He helped organize and coordinate a periodic series of technical trainings based on various technical challenges facing the implementers of the roadwork. There were over 300 participants in the trainings.

Specific training courses presented have included the following:

- -Best practices for rural roads (Esteli-May, 2000)
- -Environmental mitigation and rural road rehabilitation (Matagalpa-July, 2000)
- -Hydraulic works and rural roads (Esteli-August, 2000)
- -Unimproved rural roads (Chinandega-September, 2000)
- -Planning and proposals (Matagalpa-October, 2000)
- -Focus on gender and extension (Managua-November, 2000)
- -Environmental mitigation and rural roads (Chinandega-December, 2000)
- -Hydraulics and hydraulic structures (Matagalpa-January, 2001)
- -Techniques of minor using local materials (vegetative) (Matagalpa-April, 2001)
- -Use of GPS Equipment

**Figure 29. Periodic technical workshops were a key component in the success of the road rehabilitation work**

**Pilot Project – Animal Traction Training and Equipment Purchase**

In July 2001, a training workshop was held as part of an animal traction pilot program called FOMENTA-Animal Traction Methodology. This pilot program consisted of buying four sets of equipment (one set of equipment for each PVO--CARE, PCI, Save the Children and ADRA) to rehabilitate roads to benefit communities and families in the rural areas. Each set of equipment consisted of six items: a dumping cart for a horse; a dumping cart for an oxen; a grader; a plow; a rake; and watering equipment. Cost of each set of equipment was about $1,850.

Each PVO selected a rehabilitated road site in order to test the animal traction equipment. The PVOs received a one-week training with this methodology. The selected project sites that the FOMENTA training staff covered were CARE/Jinotega, STC/Leon, PCI/Jinotega and ADRA/Ocotal. FOMENTA road maintenance equipment was evaluated over a three-month period on difficult roads. This equipment shows promise, particularly for rural communities without access to more traditional mechanized equipment

**Ability to Sustain Repair and Maintenance Work**

Possibly the greatest accomplishment of this entire program, and what may set it apart from many other storm damage repair programs, is the training that has been provided to the local communities and the sense of empowerment they have now. A comment heard over and over from the PVOs in the field was that the people are trained and now know how to build a reinforced ditch, a gabion, a masonry ford, culvert, or wall. Also the local municipal leaders now have the skills to organize roadwork and recognize the need for sustained maintenance on the roads

## Practical Impact of USDA's Assistance

- Over 150 hurricane damage sites across watersheds in Nicaragua were rehabilitated.
- Better approaches for stabilizing streambanks against future flooding were implemented at large- and small-scale sites.
- Thousands of families benefited from projects in reforestation, irrigation system repair, soil erosion control, repair of water-crossings, and in other areas.
- Local participation in the protection of watersheds was fostered.
- Key farm-to-market roads were rehabilitated, helping the economic recovery of rural farmers.
- At least two million trees were planted to restore damaged lands and protect rivers, and thousands of seedlings growing in local nurseries for future planting.
- Many local NGOs became aware of the need to identify and address land and water resource problems within the context of a watershed.
- Local capacity was increased to design and build more storm resistant roads, reduce flood danger through streambank rehabilitation, produce viable seed for fruit and forest tree species, and to retain soil on agricultural land.

## Additional Measures to Protect the Investment/Recurring Costs

USDA provided resources and expertise for the rehabilitation of physical infrastructure such as rural farm-to-market roads, river crossings, and irrigation systems. Some of these improvements will require regular or occasional maintenance. Because of superior engineering design, such as the inclusion larger sized culverts in water crossings, fewer maintenance interventions may be needed. Other improvements, such as the addition of trees to agricultural land, or the planting of live erosion

control barriers, require only the basic type of maintenance with which farmers are quite familiar. Because building local capacity was inherent in all of USDA's activities, no significant additional measures for protecting the investment are foreseen. If additional funding becomes available in the future, it would be useful to do a follow-up review on the impact of the activities.

## Other Activities to Consider to Mitigate Future Disasters

Continuing technical assistance in the key areas of rural farm-to-market road design and maintenance, correct design and construction of water crossings, and the stabilization of stream banks and protection of rivers, would be very valuable in helping Nicaragua mitigate future disasters from extreme storm events. In addition, an increased emphasis on reforestation and protection of existing forest resources in vulnerable watersheds will help to mitigate future disasters.

Based on the experience of this project, USAID should consider addressing development concerns under a watershed approach, integrating agricultural, environment, and rural development concerns, within the context of a watershed.

***Budget for the Nicaragua HMRP: US$ 1,718,006***

(an additional $5.8 million was provided by USAID Nicaragua under a separate agreement)